

## So you want to Loop your House...

Before we get into the details of how to do this, let's start with a little history as to where this whole loop idea came from.

### What is a T-switch?

It all starts with the T-switch. Most readers know that their hearing aids have a T-switch, and you use it while using a phone that is "T-Switch compatible" or in a theater that has been "looped". While using the T-Switch, the little microphone in the hearing aid is disabled, and the only sound that is amplified by the aid is that coming through the phone, or from the PA system in the theater. This ability to cut out background noise, and only amplify the desired sounds can be very beneficial in many situations.

### How does it work?

In the "old" days, all telephones were made with small speakers that would rest against your ear when talking. These speakers worked in exactly the same way as your larger stereo speakers did. (OK, put on your physics hats) There is an electrical current passed through a coil of wire. This current flowing in the coil set up a magnetic field. As you all know, a magnetic field can move things (just like putting the two SOUTH ends of two magnets together). This magnetic field moves a light baffle (This is the circular disk we all associate with what a speaker looks like). This moving baffle moves the air in front of it, which creates the sound.

A microphone, like the one in hearing aids, works in just the opposite manner. The air moves the baffle, which moves a magnet inside a coil of wire, which creates an electrical current.

Using the T-Switch, cuts out the middle steps. The coil in the telephone driving the speaker creates a magnetic field. If you put the hearing aid close enough to the speaker, the hearing aid coil will be inside the magnetic field. This magnetic field from the phone creates an electrical current in the coil. The sound goes directly from the coil in the phone, to the coil in the hearing aid. Neither the speaker baffle nor the hearing aid microphone are needed. And only the sounds from the telephone are amplified by the hearing aid.

Most new phones made today don't use the traditional "speakers". New phone usually have a smaller, cheaper, piezo speaker. The details aren't important, except that a piezo does not have a coil, and thus the T-switch is useless with this kind of phone. So if you are buying a new phone, make sure it says "T-Switch compatible" or "Hearing Aid compatible" on the box.

By the way, the T in T-Switch stands for "telecoil" or "telephone coil"

### What is a Loop?

This T-Switch worked great for phones, and someone had the great idea of expanding the coil in the telephone to be the size of a room. Basically, that's all a looped room is. A room that has a couple of loops of wire (the coil) around it's perimeter. So once a current is passed through this coil, it acts the same as the telephone coil did. The difference is the listener is "inside the speaker". The physics work exactly the same as with a telephone. The difference is that the coil is much bigger, and thus needs a lot more power for it to work.

### Can I make my Own Loop?

With a little soldering expertise, and a bit of "do-it-yourself"ness, Yes. You will need a trip to Radio-Shack or other electronics supply store to collect wire, solder etc. You will also need to acquire an audio amplifier; new, borrowed or garage sale will do. The last thing is some method of attaching, and optionally hiding the wire around the perimeter of your room.

Be aware, that this do-it-yourself loop will not be as good as a loop system purchased for \$300 - \$600. The amplifiers in a bought system have features added to help increase the effectiveness of the system (such as automatic gain control and frequency compensation). These amplifiers have also been designed to drive a loop of wire, as opposed to speakers.

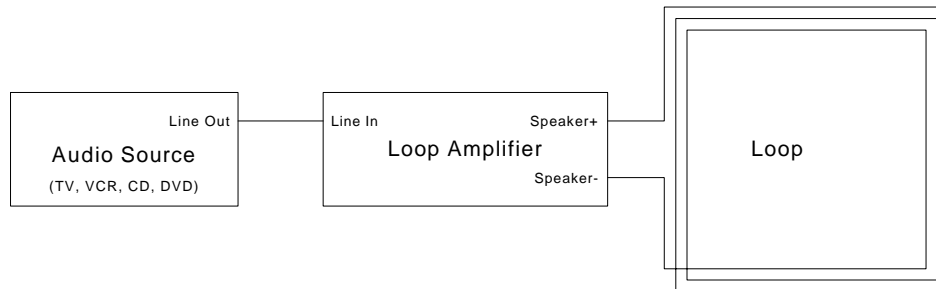
## A Word of Warning

Before embarking on this project, keep in mind that some amplifiers consider it a breach of the warranty to connect anything but speakers to an amplifiers output. Check your users manual before connecting your home made loop. In addition, if the amplifier is turned up too loud, it can do permanent damage. This is a higher risk with a loop as you can't hear how loud it is unless you are wearing a hearing aid with the T-switch.

Building this loop successfully does require some knowledge of basic electronics. If you have never soldered any wires together, or are not familiar with home stereo electronics, this may not be the project for you. This article is meant to be a guideline, and not necessarily complete step-by-step instructions. If you understand the terms in this article, and are familiar with the equipment and tools, there should be no problem building your own system.

## What are the components to a "Loop"?

There are three components to a Loop system; Audio source(s), Amplifier, and the Wire Loop itself. A diagram of the system is shown below

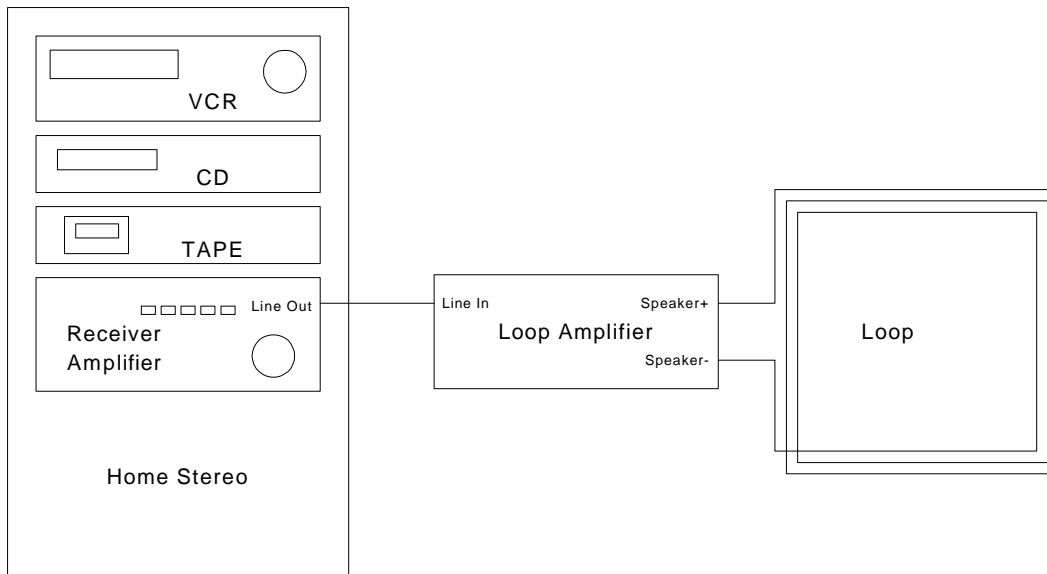


### **Audio Source(s)**

This is the easiest component to deal with. If you are considering a Loop system, you most likely already have the sources in your home. The audio source can be any of the typical sources for a home stereo: TV, CD Player, VCR, Tape, DVD etc (or even one of those large vinyl disc players....I think they were called Records??)

### **Amplifier**

You may already have a suitable amplifier in your home already. Many home stereo receivers/amplifiers will have A/B switches that are capable of driving two sets of speakers. You could possibly use the A side for your speakers, and the B side for your loop. However, the required volume level for your speakers may not be the right setting for the loop. So if you plan to use both at the same time, a separate loop amplifier would be best. If a separate loop amplifier is used, connect it to your home stereo as shown below. The line out from your home stereo receiver/amplifier goes to the Line In of your Loop amplifier. This way, your home stereo can switch between the audio sources, and the Loop volume can be adjusted separately.



In finding an amplifier for your loop, there are a few things to consider. The first is the power capability of the amplifier. The required power depends on the size of your room to be looped. A 20 Watt amplifier will suffice for a room that is less than 500 square feet (20' x 25'). Most rooms in a house are less than this, but if the room is larger, a 35 Watt amplifier will suffice for up to 1000 square feet. An amplifier with a higher power rating will work as well, the volume will just be set lower.

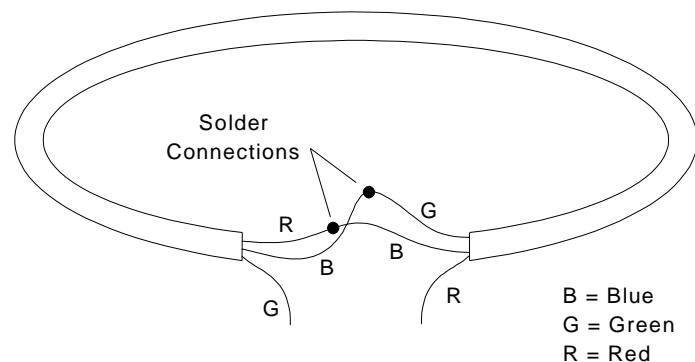
The second point to note about the amplifier is that only a single channel is required. All loops are mono. Most amplifiers have two channels (right/left). Some manufacturers specify the Right or Left channel is to be used in Mono situations. Check the user manual.

The third item to note about the amplifier is the expected speaker impedance. Most home amplifiers are built for 8Ω (ohm) speakers, although 4Ω and 16Ω are other common values. The impedance the amplifier is specified for is not crucial, but must be known to properly design your Loop.

Make sure the power is off, and the amplifier is unplugged anytime you are working with connections to the amplifier. Also be sure the volume is set low before turning on your amplifier to prevent any damage.

## The Loop

The loop itself is probably the trickiest part to set up. The loop usually is comprised of 2,3 or 4 loops of wire. The easiest way to create multiple loops is to use some cable that has a few conductors in it. The diagram below shows a cable that has three conductors, and is connected in such a way to create three complete loops of wire. This kind of cable can be purchased at any electronics components store (E.g. Radio Shack).



To determine how many loops you need, you need to know three things:

- 1) The perimeter of the room,
- 2) The resistance of the wire
- 3) The amplifier impedance rating (4, 8, or 16 ohms)

Measure the Length and Width of the room you want to loop. Then use the following equation to calculate the perimeter:

$$\text{Perimeter} = 2 * \text{Length} + 2 * \text{Width}$$

The resistance of the wire, depends on the wire gage of the conductor. Usually the wire gauge is printed on the wire itself, or you can ask at the electronics components store (it is often written as 22AWG or 22Ga.). The following table shows the resistance of typical stranded wires:

Wire Gauge	Ohms/Foot	Ohms/Meter
20	0.0109	0.0358
22	0.0175	0.0574
24	0.0277	0.0909
26	0.0444	0.1457
28	0.0707	0.2320

The amplifier impedance will be listed in the amplifiers manual, and/or printed beside the speaker terminals on the back.

### *The Calculations:*

If you multiply the Perimeter by the wire resistance, you get the resistance of a single loop of wire. (Be sure to use the proper resistance factor based on your units of measurement, meters or feet). You will most likely need a few loops of wire to match the amplifiers impedance specification. You don't have to be exact, but you want the total loop resistance to be within 0.5 ohms (for an 8ohm amplifier, the loop should be between 7.5 and 8.5 ohms).

For example:

The room is 15' x 12', You have 26 Gauge wire, and the amplifier output impedance is 8 ohms.

The Perimeter =  $2 * 16 + 2 * 13 = 58'$

The resistance of a single loop of wire =  $58' * 0.0444 \text{ ohm/Foot} = 2.58\text{ohms}$ .

Therefore we need 3 loops of wire to get 7.73ohms, which is close to the desired 8 ohms.

You may have to play with the numbers a bit to get the desired resistance. More than 4 or 5 loops is not recommended as it will start to distort the audio. If the resistance is a little too low, try adding a foot or two to the loop. You can always wrap the excess wire up behind the amplifier.

## **Connect your loop, Try it out**

Connect the two ends of your loop to one of the speaker outputs at the back of your loop amplifier. If it is a stereo amplifier, check to see if the amplifier specifies Right or Left for Mono output. Your loop system is now ready for testing.

Before turning on the amplifier, be sure the volume level is turned all the way down. Turn your hearing aid to 'T' and then turn on the amplifier and your audio source. **SLOWLY** turn up the volume on the loop amplifier until the sound is at a comfortable level.

## **Questions?**

If you have any questions regarding this do-it-yourself loop, feel free to e-mail me at [kazemir@pde.com](mailto:kazemir@pde.com).